

# Factoring by completing the square

Trinomial form:  $ax^2 + bx + c = 0$

Step 1: subtract "c" from both sides

Step 2: divide by "a"

Step 3: add  $(\frac{b}{2})^2$  to both sides.

Step 4: put into  $(x + \frac{b}{2})^2$  form

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$$x^2 + 4x - 12 = 0$$

$$x^2 + 4x = 12$$

Step 1

$$x^2 + 4x + 4 = 12 + 4$$

Step 3

$$x^2 + 4x + 4 = 16$$

Simplify

$$(x + 2)^2 = 16$$

Step 4

$$x + 2 = \pm 4$$

Square root each side

$$x = -2 + 4 = 2$$

Solve for x

$$x = -2 - 4 = -6$$

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## Compare to factoring

$$x^2 + 4x - 12 = 0$$

$$(x+6)(x-2) = 0$$

$$x+6 = 0$$

$$x = -6$$

$$x - 2 = 0$$

$$x = 2$$

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## Example

$$3x^2 + 4x - 5 = 0$$

$$3x^2 + 4x = 5$$

$$x^2 + \frac{4}{3}x = \frac{5}{3}$$

$$\left(\frac{b}{2}\right)^2 = \left(\frac{4}{6}\right)^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

$$x^2 + \frac{4}{3}x + \frac{4}{9} = \frac{5}{3} + \frac{4}{9}$$

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$$x^2 + \frac{4}{3}x + \frac{4}{9} = \frac{5}{3} + \frac{4}{9}$$

$$x^2 + \frac{4}{3}x + \frac{4}{9} = \frac{15}{9} + \frac{4}{9} = \frac{19}{9}$$

$$x^2 + \frac{4}{3}x + \frac{4}{9} = \frac{19}{9}$$

$$\left(x + \frac{2}{3}\right)^2 = \frac{19}{9}$$

$$x + \frac{2}{3} = \pm \frac{\sqrt{19}}{3}$$

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$$x + \frac{2}{3} = \pm \frac{\sqrt{19}}{3}$$

$$x = -\frac{2}{3} \pm \frac{\sqrt{19}}{3}$$

0.786

-2.119

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